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[54] FARNESYL DIPHOSPHATE SYNTHASE

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[56] References Cited

FOREIGN PATENT DOCUMENTS

0 537 553 A2 4/1993 European Pat. Off.
0 674 000 A2 9/1995 European Pat. Off.
0 699 761 A2 3/1996 European Pat. Off.
0 733 709 A2 9/1996 European Pat. Off.
409065878 3/1997 Japan .

OTHER PUBLICATIONS

Math, et al., Proc. Natl. Acad. Sci. USA, vol. 89, Aug. 1992, pp. 6761-6764.
Ohnuma, et al., J. Biol. Chem., 269:20, May 20 1994, pp. 14792-14797.

Koyama and Ogura, Mechanisms of Isoprenoid Chain Elongation Systems: Cloning and Analysis of Prenyltransferase Genes of *Bacillus stearothermophilus*, English language version of p. 174 of proceedings of the 36th Meeting for Natural Organic Compounds, Hiroshima-shi, Japan, Oct. 27-29, 1994, pp. 167-173.

Koyama, et al., J. Biochem., 113:3, pp. 355-363, 1993.
Chen, et al., J. Biochem., 268:15, pp. 11002-11007, 1993.
Chen, et al., Arch. Biochem. Biophys., 314:2, pp. 399-404, Nov. 1 1994.

Chen, et al., Protein Science, vol. 3, pp. 600-607, 1994.

Anderson, et al., J. Biol. Chem., vol. 264, pp. 19176-19184, Nov. 15 1989.

Jeong, et al., J. DNA Sequencing & Mapping, vol. 4, pp. 59-67, 1993.

Koike-Takeshita, et al., J. Biol. Chem., 270:31, pp. 18396-18400, Aug. 4, 1995.

Fujisaki, et al., J. Biochem., 108:6, pp. 995-1000, 1990.

Ashby, et al., J. Biol. Chem., 265:22, pp. 13157-13164, Aug. 5, 1990.

Teruya, et al., Mol. Cell. Biol., 10:5, pp. 2315-2326, May 1990.

Sheares, et al., Biochemistry, 28:20, pp. 8129-8135, 1989.

Wilkin, et al., J. Biol. Chem., 265:8, pp. 4607-4614, Mar. 15, 1990.

Armstrong, et al., Proc. Natl. Acad. Sci. USA, vol. 87, pp. 9975-9979, Dec. 1990.

Scolnik, et al., Plant Physiol., vol. 104, pp. 1469-1470, 1994.

Aitken, et al., Plant Physiol., vol. 108, pp. 837-838, 1995.

Badillo, et al., Plant Mol. Biol., vol. 27, pp. 425-428, 1995. Plant Physiol., 108:3, p. 1343, 1995.

Lang, et al., J. Bacteriol., 177:8, pp. 2064-2073, Apr. 1995.

Armstrong, et al., Mol. Gen. Genet., vol. 216, pp. 254-268, 1989.

EMBL release 45, Dec. 1995 (14 pages).

Carattoli, et al., J. Biol. Chem., 266:9, pp. 5854-5859, Mar. 25, 1991.

Koyama, Can. J. Chem., vol. 72, pp. 75-79, 1994.

Ohnuma, et al., J. Biol. Chem., 271:17, pp. 10087-10095, Apr. 26, 1996.

Koyama, et al., Biochemistry, 33:42, pp. 12644-12648, 1994.

Ohnuma, et al., J. Biol. Chem., 271:31, pp. 18831-18837, Aug. 2, 1996.

Tarshis, et al., Biochemistry, 33:36, pp. 10871-10877, 1994.

Koyama, et al., Biochemistry, 35:29, pp. 9533-9538, 1996.

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[57]

ABSTRACT

A mutant prenyl diphosphate synthase capable of synthesizing prenyl diphosphates, shorter than those synthesized by the original enzyme, by modifying the amino acid sequence in and upstream of the aspartic acid-rich domain DDXX (XX)D (X denotes any amino acid, and XX in the parentheses may not be present) present in region II of the prenyl diphosphate synthase.

16 Claims, 3 Drawing Sheets